HEATER WIRE FOR DEVICE SUCH AS AN IMPULSE SEALER

BACKGROUND OF THE INVENTION

The present invention relates to an impulse sealer, a book binding machine and a laminator which thermally melts and adheres material such as polyethylene.

BACKGROUND ART

An impulse heat sealer causes a current of 8-15A to flow through a heater wire having a width of about 2-5mm, heats the heater wire to about 150°C for a short period of time, about one second, and melts and adheres polyethylene and thermally meltable resin. With regard to the heater wire, a heat generating portion, therefore, uses a narrow width wire member having a high electrical resistance such as iron chromium and nichrome, and an electrode portion which requires no heat generation and made from, for instance, comparatively thick plated copper plate and iron plate, both being connected, such as by press contacting and spot welding.

Although a large current flows through the sealer, since the length of the sealer is about 20-40 cm, a voltage which appears at the both ends thereof which reaches to about 15-30V. For this reason, the standard commercial power source voltage of 100-

220V has to be adjusted by making use of a voltage regulator such as a transformer and an electronic circuit.

Since the press contacting and the spot welding of the heater wires is manual work, which requires human senses, it may cause irregular time usages of the heater wires, leading to defective products and lack of accuracy, and that tends to cause overheating of the connected portion and, thus, shortens the lifetime of the heater wires.

Further, the electrode, which is press contacted and spot welded and has a substantial thickness, the thick electrode portion can not be mounted on a heater stand, therefore, and when a conventional expansion absorbing device 15 as shown in Fig. 5 is used, and the heat generation portion is extended, both ends thereof float in the air and are overheated. Therefore, it has frequently happened that holes are formed in the polyethylene over the over heated portions.

Furthermore, the transformer is very heavy. Because the voltage regulator keeps the electronic circuit voltage low in comparison with the power source voltage resulting in the current being large, this makes the control of the voltage regulator difficult and, fault likely occurs. In addition, the prices of these two components are high.

In the book binding machine and the laminator, a metallic bar and a roll having a large thermal capacity are heated by a heater which is formed by winding a nichrome wire around a mica plate and is used under a thermal equilibrium state.

Even if the amount for processing is slight, there is a waiting period of 5 to 10 minutes until the metallic bar or the roll are heated.

A prior art of the present invention, JP (U)-A-57-167004 (herein below will be referred to as the reference) discloses a zigzag shaped heater wire which is formed by cutting slits on a tape shaped metallic layer pasted on a glass epoxy resin substrate from both sides thereof alternatively in perpendicular direction to its longitudinal direction, and of which configuration is very similar to the present invention. However, the objects of the reference citation are to prevent breaking of the heater wire due to the force of a thermal expansion by using a spring, to eliminate changes by narrowing of a broad width heater wire and also to enhance heat dissipation properties. The prior art, however, is silent about eliminating the zigzag shape on a seal line by decreasing the gap of the respective slits, and never refers to such an object.

With regard to the gap size, the reference indicates that the gap size is about three times larger than the thickness of the metallic layer. Since the thickness thereof in as embodiment of the reference is 0.1mm, the gap becomes 0.3mm, but, in reality an iron chrome thin plate with no tempering having a thickness of 0.1mm cannot maintain this given shape. The heater wire's shape, according to the present invention, can be maintained without trouble. An experiment was performed with a teflon coated glass tape of 0.1 mm covering the produced heater wire, which was heat sealed according to the embodiment of the reference, gaps clearly appeared on a seal line. If a metallic wire with no tempering is used, thickness of 0.2mm is required, then according to the

reference the gap will amount to 0.6mm, with the gaps clearly appearing on the seal line.

Therefore, from the disclosure in the reference, "the seal width is 5mm corresponding to the width of rectangular pulse wave as shown in Fig. 1". This suggests that the seal line is in a zigzag shape. However, if the gaps on the seal line disappear, it is presumed that this will be caused by the heat accumulation. Because the reference indicates that the scaling time is 4 seconds, which is 4-8 times longer than a sealing time of 0.5-1 second of a usual sealer, it is presumed that this is because of poor heat dissipation. This is contrary to the original object of the reference, because the reference nowhere suggests that the gaps should be limited as much as possible.

Further, in the citation, it is necessary to keep the shape of the metallic plate by adhering the same on a glass epoxy resin substrate. However, in order to reduce cost in mass production with regard to metallic portions, photo exposure and etching is performed over a broad area, therefore, the reference raises problems and includes unsolved problems as follows. How the glass epoxy resin substrate is cut? How can the heat resisting property of the epoxy resin substrate be maintained when the operation temperature of the sealer for such as PP rises to more than 150°C? What sort of adhesives having durability are used? How is the heat dissipation achieved due to the closely contacted substrate as referred to above? Is the sealing time is prolonged because of the heat absorption by the substrate? Can both ends of the lead wire portion be taken to the outside in a flat state with both ends of the lead wire portion also serving as the pressing faces?

SUMMARY OF THE INVENTION

It is an object of the invention to provide a heater wire is formed in such a manner that a thin plate of resistance material, such as iron chromium, which is further thinned by rolling, and is properly strengthened, such as by tempering, and is processed by photo-etching then the width of electrode portion a portion, which is required to suppress heat generation, is broadened so far as permitted; a heat generating portion is shaped into a desired configuration with a narrow uniform width, then both portions are integrated.

It is a further object of the invention to provide a measure which is applied to the electrode portion to eliminate the drawback of swelling in a seal line.

It is another object of the invention to provide a heater wire which is formed in a zigzag shape of narrow uniform width over the entire desired configuration of the heat generation portion, which causes gaps in the formed seal line or plane to disappear due to heat diffusion from the heater wire.

A still further object of the invention is to provide, by making use of the heater wire, an impulse-type book binding machine and laminator produced in which heating is performed instantaneously to melt an adhesive on an inside resin and which then interrupts the current supply to cool the same.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Figs. 1 through 3 are plane views of embodiments of heater wires of the present invention and embodiments of seal lines in the formed melting and adhering traces through sealing.

Fig. 4 is a side view showing an expansion absorbing structure of a heater wire 30 caused by itself.

Fig. 5 is a side view of a conventional expansion absorbing structure.

Figs. 6 and 7 are plane views showing application embodiments of the heater wire of the present invention.

Fig. 8 is a plane view showing an embodiment of heater wires of the present invention for a bag with a cat pattern.

Fig. 9 is a plane view showing a zigzag shaped heater wire and the seal line formed thereby.

Figs. 10 through 12 are enlarged plane views of heat generating portions thereof.

Fig. 13 is a plane view showing another heater wire.

Fig. 14 is a plane view showing a connecting portion with a heater wire.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 is a plane view of a heater wire 1 and its seal line 2 in an example of the present invention. The heater wire 1 includes a heat generating portion 3, having a width of 2mm, and electrode portions 4, having widths of 5mm, which are formed from a same plate member by photo etching. In this process, a thin plate is formed by rolling an iron chromium material into 0.1mm thickness, and then is adjusted into a proper hardness. By use of a photosensitive material coated in advance, after photo-masking a pattern, and after the coated photosensitive material is exposed and fixed, a further covering film may be applied, with dissolving and removing unnecessary portions by acid to complete the patterned product. In the electrode portions of the present invention, even if the same resistance material is used, when the width of the electrode portions is broadened more than about two times, it can be controlled and no sealing is effected at the portions.

When the heater is used for household use, in which the number of usages is small, no problems occur, however, when the heater is used continuously, the heat in the heat generating portion gradually spreads into the electrode portions 4, swellings 5 are formed in the seal line 2 of the heater wire 1 due to the width expansion of the electrode portions 4 at both ends thereof. If a force is applied, the seal is likely broken. Therefore there are three countermeasures to correct this problem.

The first countermeasure is to place heat absorbing electrode plates 6 at the positions of the electrode portions 4, so as to overlap therewith, as shown in Fig. 2, thereby, the heating is stopped at their overlapping portions. This is shown by the seal line 7, and the heat absorbing electrode plate 6 which is disclosed in Japanese Patent Application No. Heisei 8-346654, which is a thin plate of alloy materials having good electrical and, in particular, thermal conductive property such as nickel plated phosphate bronze. Drawbacks of this measure are the increase in the number of parts correspondingly and, because of current flow between the heat generating portions 3 and the heat absorbing electrode plates 6, the heater wire is consumed comparatively rapidly at the contacting portions.

A second countermeasure is, in order to prevent swelling of the seal line at the side of the bag main body, by to offsetting the heat generating portion 3 from the center, by eliminating a width broadened portion 8 at the side of the bag main body, and by doubling the width at the opposite side, as shown in Fig. 3. The width broadened portions near both ends, in comparison with the width broadened portion 9, at the opposite side, form the side of the bag edges. In this instance, although the swelling 11 on the seal line is formed, it only appears at the side of the bag edges. Thus the swellings are aligned at one side where the negative influence is small.

The same effect can be obtained if the heater wire 1 is bent perpendicularly along the broken lines 12 as in Fig. 3. This is for preventing unnecessary elongation of the sealer. When the electrode portion 4 is bent perpendicularly, as illustrated by the side view in Fig. 4, a pillow shaped projection 14 is formed above the fixing screw 13.

By applying a tension to screw 13, the elongation of the heat generating portion is sufficiently absorbed by the electrode portion because of the spring property of it now possesses, thus the need for the conventional complex elongation absorbing device 15 requiring many parts is obviated.

The heat generating portion 3 can be formed in any shape other than a straight line. An elliptical heater wire 16, in Fig. 6, as used for a molding handle of a polyethylene shopping bag is shown, and, in addition, a rectangular heater wire 17, shown in Fig. 7, for sealing an outer frame of a bag shaped filter is also depicted. Further, since the heater wire 17 is required to form a closed space by the rectangular seal line, the gap at a nearby portion 18 is set below 0.2mm, thus causing the gap on the seal line to disappear.

Such relationship between gap and seal line may occur in any heater wire. Fig. 8 shows a heater for a shopping bag with an inflatable cat's head which is usually manufactured by a balloon method as disclosed in U.S. Patent No. 5,545,117. In this reference, a heater wire 20 of nichrome round wire is used for sealing and burning off the outer configuration, and a heater wire 21 is used for sealing in order to separate the cat head from the inside of the shopping bag. Copper wires are connected along dotted portions 22 at both ends thereof to prevent heat generation. The heater is formed in such a manner that after arranging these round wires into a desired configuration, these are fixed by fluoro resin coated glass cloth with adhesive to fix the same. The cat face and the handle are illustrated to facilitate understanding of the above explanation.

In this instance, at the portions where the two heater wires are in close proximity, in the two portions of the root portion of ear and jaw portion, air tightness is necessary. The heater wire 21 is closely contacted at the portions by adhering a glass tape having thickness of about 0.1mm, but electrically insulating one portion from the other. Because of adhering the tape at the portions, the sealing temperature tends to be lower, but because the heater wires are closely located, this tendency is cancelled out. Further, through controlling the supply current, the above arrangement is operated sufficiently, and it was found out that no air leakage gap was formed in the resultant seal line.

A heater wire, which makes use of the above arrangement is one shown in Fig. 9. Here the width of the resistance material is narrowed and fine slits are cut in a heat generating portion 23, to form a uniform zigzag perpendicular to the longitudinal direction thereof. Figs. 10 through 12 are partially enlarged views thereof. When these heater wires are used, and the slits are sufficiently small, a beautiful single seal line 24 can be obtained. Further, the zigzag is interrupted immediately before the electrode portions at the both ends and is restored to the original width. No problematic end swellings appear on the seal line 24, which is the third countermeasure.

The resistance value of the zigzag shaped heater wire is about 25Ω when fine slits of about 0.2mm are cut on the heat generating portion 23, with intervals of about 0.4mm in a zigzag manner. In contrast, an electrical resistance of a heater wire having the width of 2mm and length of 200mm, forms the same seal line as above with 2Ω. Therefore, in the electrical point of view, the latter conventional heater wire requires about 16V and 8A,

while the heater wire of the present invention forms the same seal line, as the conventional one, requiring a high voltage of 50V and a low current of 2A.

If the commercial source voltage is 100V, it can be applied by subjecting the same to half-wave rectification, or further if the length of the heater wire is elongated by 1.4 times to 280mm, the commercial source voltage of 100V can be directly applied to the heater wire. Still further, if the commercial source voltage is 200V, when the length of the heater wire is elongated by a factor of two, the commercial source voltage can be applied to the heater wire after subjecting the same to half-wave rectification. When the width of the heater wire is modified to 3mm, and the length thereof is elongated in total to three times, the commercial source voltage of 200V can be applied as it is, obviating the need for a transformer and a voltage regulating circuit.

Since the zigzag shaped heater wire of the present invention remains fixed while minimally expanded, the expansion and contraction due to heat can be absorbed by the heater wire itself, thus the need for the conventional complex expansion absorbing device as shown in Fig. 5 is obviated as well as the simple device as shown in Fig. 4.

The reason why the gaps disappear from the seal line when the heater wire contains the gaps, is that the heat generated is transferred toward the gaps via the covering fluoro resin coated glass tape, and also by the polyethylene film itself, as it is sealed. Therefore, if the usual thickness of 0.1 - 0.2mm is further thickened, or the generated thermal amount and the generating time are increased, the gaps on the seal line will disappear even if the gap is more than 0.2mm. Further, a gap of less than 0.1mm is,

of course, preferable, however, mass production using etching will become difficult. Within the defined range, a gap having a taper as shown in Fig. 11 is acceptable.

Further, it is permitted to modify the width of the heater wire, since the heat generation amount is non-proportional to the width. In addition, by varying the sizes of the gaps, heaters having a variety of effects can be manufactured. For example, as shown in Fig. 12, although the heater has the same or the substantially the same configuration with regard to sealing, the temperature distribution thereof is varied in such a manner that at the center portion in the width of the heat generating portion is set high and the surrounding portion thereof is set lower, thereby preventing possible edge cutting. In fact, since the heat generating density is also non-proportional to the interval of the gaps, the same effect, such as found by increasing the taper of the gaps in the heater wire as shown in Fig. 11, can be obtained.

With an annealed material such as iron chromium material and nichrome alloy, a heater wire having width of even 2mm is soft and deforms during treatment thereof, if the thickness thereof is not about 0.2mm. Since today, a thin plate having thickness of 0.1mm can be manufactured by economical rolling, and the thin plate can be strengthened through a proper degree of quenching, a heat generating portion having a zigzag in the interval of 0.4mm as referred to above demonstrates a sufficiently practical strength. However, if the tempering is too strong, the zigzaged heat generating portion is likely to break, therefore, the quenching amount has to be proper.

Since the operating temperature of the heater wire is below 200°C and is far below the quenching temperature of more than 600°C, no tempering occurs due to the

heating. Further, other than the tempering, a strengthening process, such as reforming by means of such as rolling and forging can be applied. To sum up, with regard to thickness of the heater wire, the thinner, the better, so long as the strength thereof can be supplemented such as by tempering. The zigzag direction in the longitudinal direction as shown in the plane view in Fig. 13 can be used, however, since each zigzag length is longer, further higher mechanical strength is required. Accordingly, the strength thereof depends on the properness of its configuration design. Further, in the case of the heater having a broad area as shown in Fig. 13, any manner of covering the area with the wires and gaps are permitted, thus any zigzag shape is considered within the scope of the invention.

Further, other than the zigzag shape defined only by straight lines, zigzag shapes defined by curved lines are also included and, other than the heat generating wire itself of straight line any shapes of heat generating wires, such as a curved one and one having different widths can be used.

Further, as processing methods thereof, wire cutting and laser cutting can be used. Although a heater wire is not an expensive article, a transformer can be omitted by modifying the processing of the heater wire, the heater wire can be manufactured in view of the saved cost of omitting the transformer. Accordingly, although the etching is a very economical method, the present invention is not limited thereto. Other than the zigzag shaped heat generating portion 23 formed integral with the electrode portion 4, as shown in the plane view in Fig. 14, the present invention includes an arrangement in which the

zigzag portion is connected via a width broadened connecting portion 25 to the electrode portion 4 through spot welding.

Further, the sealer pressing mechanism of the present invention includes a pressing operation in which a worker grips a T shaped hand type handle being provided with a heater at one side thereof by the hand, and performs heat sealing by pressing the same on polyethylene placed on a work stand. Further, since the present heater can be operated while omitting the voltage regulator, the power source circuit can be a simple current supply from the power source to the heater. Further, since the impulse sealer of the present invention is lightweight and can be directly coupled to a power source, the present impulse sealer can be actively used in a field where only heating plate type heaters are conventionally used.

The above can also be applied to a book-binding machine and a laminator using a conventional plate type heater, the impulse heat sealer of the instant invention applied thereto. For instance, a fluoro resin tape covering a zigzag shaped heater wire shaped into a necessary configuration, can be used with a press mechanism, incorporating the same for book binding, and when laminated films are pressed, a comparatively large current is fed thereto for a short time to heat the same and then is interrupted to cool the same, whereby allowing an adhesive of heat-meltable resin to be melted and adhered. For example, since the zigzag shaped heater wire can be shaped in a rectangular shape, such heater wire is suitable for laminating a photo for an identification card. Such heater can be used any time when desired, in addition, the instant heater is not required to be always heated, which contributes to energy saving. The heating equipment such as the impulse

heat sealer as defined in the preferred embodiments herein, may be used in book binding equipment and other laminating machinery as known to those of ordinary skill in the art.

INDUSTRIAL APPLICABILITY OF THE INVENTION

According to the present invention, since the heater wires can be formed by making use of photoetching, heater wires of any configurations can be manufactured accurately in large amount and with low cost, in addition, causes of shortening life time of the heater wire such as overheating due to poor spot welding is eliminated. Since the electrode portions are formed as thin as the heat-generating portion, the electrode portions can be extended over on the heater stand. Thus, the undesirable formation of penetration holes on a processing subject due to overheating as well as due to the air bubbles in a part of the heat generating portion, which likely happens at both ends of the conventional extension absorbing device, is prevented.

Further, since the zigzag shape of the heater wire is formed with narrow slits, which cause disappearance of the slit gaps on the seal line, the voltage applied to the heat generating portion can be approximated to the voltage of the power source. Thereby, the need for a voltage regulator such as a transformer is obviated and the structure is simplified. Because the heavy transformer is omitted, the weight of the present device becomes very light and the cost thereof is lowered.

Further, since possible distortion due to thermal expansion can be absorbed by the spring property of the heater wire itself, the zigzag shaped heat generating portion further enhances the distortion absorbing effect, thereby, extension absorbing devices which usually have to be provided at the both ends of the heater wire are simplified or unnecessary.

Thus, the impulse heat sealer itself can be easily manufactured and the cost thereof can be lowered considerably.

Further, by making use of the heater wire of the present invention, an impulse heat sealer type book binding machine and laminator can be manufactured, and the present heater wire can be used instantly which contributes to energy saving.

Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

ABSTRACT

A heater wire which can be used in an impulse heat sealer, a book binding machine, a laminator, an image-creating device, and so on. A thin sheet of resistant material such as iron-chromium alloy is further thinned by rolling, properly strengthened by quenching, and processed by photo-etching so that the width of a heat-generating part is small and those of the electrodes are larger that that, thus integrally producing a heater wire. The heat-generating part of the heater wire is zigzag at such small intervals that the zigzag pattern disappears on a sealing line or plane because of heat diffusion, and the